

Vapor Intrusion

Issue

What rule revisions, if any, are needed to clarify requirements for evaluating and responding to the potential for vapor intrusion threats?

Problem Statement

The migration of gas-phase chemicals through the subsurface and, potentially, into overlying buildings is referred to as vapor intrusion. The Model Toxics Control Act (MTCA) cleanup regulation refers to the possibility that subsurface contamination could pose a threat to indoor air quality, and requires that certain actions be taken to evaluate this possibility.¹

However, the current regulations are unclear regarding requirements for assessing the vapor intrusion pathway during the remedial investigation (RI). Furthermore, the rule lacks clear direction for establishing cleanup levels protective of indoor air quality.

Cleanup proponents and Ecology site managers are unclear regarding how vapor intrusion should be assessed during the RI, what approaches should be used to respond to the threat if indoor air indeed appears to be unacceptably impacted, and how to establish that the pathway is not causing unacceptable impacts.

The Department of Ecology is considering whether rule revisions are needed to clarify requirements. Ecology is also considering:

- If and how to incorporate new scientific information and new state and federal guidance into the rule.
- How to identify predictable methods for evaluating and responding to potential health risks posed by vapor intrusion.

Background

In 1991, Ecology first published rules implementing the Model Toxics Control Act. The 1991 cleanup regulation included a few general provisions applicable to the subsurface movement of vapors. Ecology completed significant changes to the MTCA rule in February 2001. These amendments include new provisions to more specifically address the vapor intrusion pathway.

¹ See particularly WAC 173-340-740(3)(b)(iii)(C).

The MTCA cleanup regulation provides three ways to establish cleanup standards for soil. Method A was intended for simple sites with few hazardous substances. Method B applies to all sites and consists of two approaches: standard and modified. The standard method uses default values and formulas. The modified method uses chemical or site-specific values in those same formulas. Method C applies to specified site uses or conditions (typically industrial sites).

Soil concentrations that protect human health are typically determined by evaluating the following pathways:

- Direct contact with contaminated soil (via ingestion and dermal absorption).
- Contaminants leaching from soil into groundwater at concentrations exceeding groundwater cleanup levels (the leaching pathway).

Groundwater cleanup levels are typically determined by evaluating the following pathways:

- Ingestion of the groundwater as drinking water.
- Contaminants in the groundwater migrating into surface water and sediment.

Certain contaminants can volatilize from groundwater or subsurface soils and potentially move as vapor through the soil. Method A soil and groundwater cleanup values have not been checked to determine if they are sufficiently protective of the vapor pathway. The vapor pathway is not normally evaluated under MTCA unless certain triggering criteria are met.

This lack of specificity in the regulation has led to confusion and concern among Ecology site managers and the regulated community who understand that vapors should be evaluated but are uncertain as to requirements under Washington law.

The MTCA cleanup regulation:

- Lacks definitions of vapor intrusion and soil gas.
- Does not specifically state that the vapor intrusion pathway be investigated during the remedial investigation and feasibility study.
- Does require that the remedial investigation evaluate air quality impacts.²
- Includes a general requirement that cleanup levels for a specific media (for example, groundwater) must be established at concentrations that do not directly or indirectly cause violations of cleanup levels for other media (surface water, sediments, soil, or air), but lacks specifics,

Establishing Cleanup Standards

Soil Cleanup Standards Lack Specificity Regarding VI

Requirements for establishing soil cleanup standards are provided in WAC 173-340-740 and 745. Ecology can establish soil cleanup levels more stringent than values otherwise established in these sections if necessary to protect human health. The example provided is a site where

² WAC 173-340-350(7)(c)(D)

concentrations must be established that eliminate or minimize the potential for vapor accumulation in buildings or other structures.

For soil contaminated with volatile organic compounds, these sections require that the soil to vapor pathway be evaluated under three scenarios. Two of the scenarios concern petroleum contamination. The third scenario arises when volatile organic compound (VOC) levels in soils are “significantly higher” than concentrations established to protect groundwater as a drinking water source.³

When using Modified Method B or C, chemical specific or site specific adjustments can be made to the parameters used in calculating soil cleanup levels. If these modifications result in significant higher cleanup levels, then the rule requires that the dermal adsorption pathway and the soil to vapor pathway also be evaluated.

Evaluating When Soil Cleanup Levels Protect Indoor Air

Sections 740 and 745 present the evaluation methods that may be used to determine soil cleanup levels protective of indoor and ambient air. Four methods are listed:

- Measure soil vapor and demonstrate that vapors do not exceed air cleanup levels
- Measure ambient and/or indoor air and demonstrate that air does not exceed air cleanup levels
- Use a model to demonstrate that air cleanup standards will not be exceeded
- Other methods, approved by the department, to demonstrate that air cleanup standards will not be exceeded

Groundwater

The MTCA cleanup regulation includes requirements for establishing groundwater cleanup standards. It generally states that groundwater cleanup levels must not cause violations of air cleanup standards.

The regulation allows Ecology to establish groundwater cleanup levels more stringent than values otherwise established in section 720 if necessary to protect human health. This provision applies to all hazardous substances including volatile organic compounds, semi-volatile compounds, and inorganic compounds. An example provided is a site where concentrations must be established that eliminate or minimize the potential for vapor accumulation in buildings or other structures.

³ WAC 173-340-200 includes the following VOC definition: "**Volatile organic compound**" means those carbon-based compounds listed in EPA methods 502.2, 524.2, 551, 601, 602, 603, 624, 1624C, 1666, 1671, 8011, 8015B, 8021B, 8031, 8032A, 8033, 8260B, and those with similar vapor pressures or boiling points. See WAC 173-340-830(3) for references describing these methods. For petroleum, volatile means aliphatic and aromatic constituents up to and including EC12, plus naphthalene, 1-methylnaphthalene and 2-methylnaphthalene.

Air

The MTCA Cleanup Regulation includes requirements for establishing cleanup standards to protect air quality.⁴ Although vapor intrusion is not specifically mentioned, the air cleanup standards apply to both ambient air and air within any building, utility vault, manhole, or other structure large enough for a person to fit into.

New Scientific and Regulatory Information

Since the 2001 rule revisions, there have been several important scientific and regulatory developments associated with evaluating and responding to vapor intrusion problems.

EPA 2002 Draft Guidance: EPA has published draft guidance for assessing and responding to vapor intrusion problems (EPA, 2002). While EPA decided not to finalize this document, the draft guidance provides a screening process for identifying chemicals that are sufficiently toxic and volatile to pose a potential vapor intrusion threat. Several EPA regional offices have developed guidance on this issue.⁵

EPA Research and Information Compilation: The EPA draft guidance document includes physical, chemical and toxicological information for a wide range of volatile hazardous substances. EPA has continued efforts to evaluate empirical data and has created a large database on vapor attenuation factors.⁶ Conferences are held annually by several organizations that feature vapor intrusion-related research topics.

ITRC Guidance Document: The Interstate Technology and Regulatory Council (ITRC) has published a vapor intrusion guidance document.

ASTM Vapor Intrusion Standard: The American Society for Testing and Materials (ASTM) has issued a standard related to vapor intrusion concerns during property transactions.

Several states have developed comprehensive state-specific guidance materials for evaluating and responding to vapor intrusion problems. These states include California, Massachusetts, New Jersey, New York, and others.

⁴ WAC 173-340-750 provides air cleanup standards for use in determining if air emissions at a site pose a threat to human health or the environment.

⁵ Recommendations for Human Health Risk-Based Chemical Screening and Related Issues at EPA Region 10 CERCLA and RCRA sites, EPA Region 10, April 17, 2007.

⁶ Dawson, USEPA Region 8, Analysis of Empirical Attenuation Factors in EPA's Expanded Vapor Intrusion Database, presented at Air & Waste Management Association (A&WMA) conference on Vapor Intrusion, "Learning from the Challenges," Sept. 26-28, 2007, Providence, RI.

In Washington, Ecology has begun to see the vapor intrusion pathway become an issue at more sites. Specifically, vapor intrusion has been a major issue at several sites in the Georgetown area of Seattle and a large site in the Vancouver area.

Rulemaking Options Being Considered

Ecology is considering several options for addressing vapor intrusion in the MTCA cleanup regulation. These include:

Develop Guidance Materials: Guidance could be issued without regulatory changes or in tandem with regulatory changes. Guidance would be updated if needed after rule revisions are complete.

[Ecology intends to issue vapor intrusion guidance in early 2010. The guidance addresses:

- The conditions under which vapor intrusion assessment is needed
- How to assess vapor intrusion cost-effectively during the remedial investigation
- Measures available for “mitigating” vapor intrusion
- Procedures for deriving subsurface cleanup levels protective of indoor air quality
- Instructions for, and limitations on, using the Johnson and Ettinger vapor intrusion model]

Minor Rule Revisions to Clarify Regulatory Terms: Under this option, Ecology would only make minor revisions to the current rule in order to clarify certain terms. In particular, Ecology would clarify the term “significantly” in the phrase “...*concentration is significantly higher than a concentration derived for protection of ground water for drinking water beneficial use under WAC 173-340-747(4)....*” This option could include reorganization to make the requirements easier to understand, but would include little or no substantive changes.

Adding a New Section to the MTCA Cleanup Regulation: Ecology is considering adding a new section devoted to vapor intrusion. The new section would include requirements for establishing subsurface media cleanup levels protective of indoor air quality (via this pathway). Changes in other sections would clarify the need for assessing the potential for vapor intrusion at sites contaminated with volatile, toxic substances.

Revising Existing Rule Sections: Revisions could establish default policies and methods for a number of sections. (See Table 1.)

Table 1: Options under consideration		
Current Provision (WAC 173-340)	Under Consideration	Comment
-200 definitions: Volatile substances definition limited to organics measured with certain analytical methods	Expand the term to include criteria for vapor pressure, boiling point, and Henry's Law constant.	This change would reflect how volatile substances are currently defined in CLARC.

<p>-350 remedial investigation:</p> <p>Vapor intrusion is not specifically mentioned. Nor is there a requirement to perform a vapor intrusion assessment when site contaminants include VOCs.</p>	<p>Revise WAC 173-340-350(7)(D) so that a vapor intrusion assessment is required during the RI if site contamination is volatile.</p>	<p>The trigger for an assessment would be consistent with forthcoming guidance.</p>
<p>-704 Method A</p> <p>Vapor intrusion is not mentioned. It is not clear whether Method A table CULs are protective of indoor air.</p>	<p>Option 1: Limit use of Method A cleanup levels at sites where the remedial investigation finds vapor movement is a concern in groundwater and/or soil.</p> <p>Option 2: Revise the Method A groundwater and soil cleanup levels to take into account the vapor intrusion pathway.</p>	<p>Revising the Method A cleanup levels to account for vapors could lower these cleanup levels considerably, depending on the assumptions made in the calculations. This could render use of these values impractical at many sites.</p>
<p>-720 groundwater cleanup levels:</p> <p>Methods for deriving groundwater cleanup levels, protective of indoor air quality, are not described. The point of compliance discussion does not directly consider vapor off-gassing from groundwater.</p>	<p>Add sections describing the alternative approaches for ensuring that Method B and C groundwater cleanup levels are protective of indoor air quality.</p> <p>Revise -720(8) to account for the groundwater point of compliance when vapor intrusion is a concern.</p>	<p>It is not obvious at present (in the regulations) how PLPs should establish groundwater cleanup levels at a site to protect indoor air quality or measure compliance. This could be stated clearly.</p>
<p>-740 & 745 soil cleanup levels:</p> <p>Methods for deriving soil cleanup levels, protective of indoor air quality, are described in WAC 173-340-740(3)(c)(iv)(B) (with similar provisions in 745). However, using one of these methods is only required if certain conditions are met.</p> <p>Few specifics are provided for evaluating compliance for sites with soil vapor issues.</p>	<p>Revise the triggering criteria for evaluation of soil vapors so that the VI pathway must be evaluated in most circumstances where volatile contaminants are present, similar to how the terrestrial ecological exposure pathway is handled (screening/exclusion criteria, simplified evaluation methods, site-specific evaluation options).</p> <p>Consider adding more specific methods for determining compliance when soil vapors are an issue at a site.</p>	<p>Means of establishing VI-protective cleanup levels in 740(3)(c)(iv)(B) (and similar provisions in 745) are fairly inclusive and many not need to be significantly modified.</p> <p>However, EPA studies indicate it is difficult to draw a correlation between soil and vapor concentrations. Thus, determining compliance by measuring soil concentrations may not work well.</p>
<p>745 air cleanup levels:</p> <p>Formulas for deriving air cleanup levels are provided in the rule. Limited specifications are provided for measuring compliance.</p>	<p>Ecology plans to evaluate the air cleanup level formulas and compliance methods for conformance with the latest methods used by EPA and other states.</p>	<p>Background air concentrations for certain chemicals is a major issue in urban areas. How to handle background when determining cleanup levels will also likely need to be addressed.</p>

Factors to Consider When Selecting an Option

Developing amendments to the MTCA cleanup regulation will require considering and balancing a number of issues and interests. Proposed amendments must also satisfy several regulatory goals, including the following:

- Providing for the selection of cleanup actions that protect human health and the environment.
- Developing scientifically and legally defensible cleanup standards.
- Providing consistent standards and methodologies for assessing and managing risk.
- Providing flexibility to address site-specific factors.
- Promoting efficient and cost-effective cleanup of contaminated sites.
- Providing enhanced opportunities for public involvement.
- Improving the clarity and usability of the rule.
- Availability of analytical methods.
- Availability of sufficient toxicity information to establish cleanup levels.